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THE LINK BETWEEN FX SWAPS AND CURRENCY STRENGTH DURING THE CREDIT CRISIS OF 2007-2008

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Abstract

This note analyses the impact of the global credit crisis on the FX swap market and discusses its potential implications.   The turbulence in money markets has spilled over to FX swap markets amid a reappraisal of counterparty risks during the recent financial turmoil.   We examine the situations of six currencies: the euro, the British pound, the Australian dollar, the Japanese yen, the Hong Kong dollar and the Singapore dollar.   We find that (i) the risk premiums have indeed gone in tandem with the spreads of money market rates over their corresponding overnight index swaps across the economies, a popular measure of potential banking insolvency; and (ii) the risk premiums bear a negative relationship with the strength of the spot rates of the respective currencies, which is consistent with the increased pressure in the swap markets.

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I.   INTRODUCTION

The abrupt escalation of the recent global credit crisis last September marked an important turning point for many currencies. Those that had exhibited remarkable strength in the recent past (e.g., the British pound, the euro, the Australia dollar) depreciated abruptly, while others (e.g., the Japanese yen, the Hong Kong dollar) rallied strongly. At the same time, unusual pricing behaviour occurred in the foreign exchange (FX) swap market, revealing significant and persistent departure from covered interest parity, a well-established and well-tested theory in international finance. What messages are these atypical phenomena sending us? This note attempts to shed light on these questions by looking at the FX swap market more closely and finding that the two phenomena appear to be linked.

II.   COVERED INTEREST PARITY IN FINANCIAL TURMOIL

The interest parity theory states that the equilibrium forward exchange rate F is:

$$F = \frac{S(1+r)}{(1+q)} \quad , \tag{1}$$

where S is the spot exchange rate (the domestic currency value of a unit of the US dollar), r and q are, respectively, the domestic and the US dollar rates of interest on securities that identical in all respects except for the currency of denomination. The market forward exchange rate F^* gives a swap-implied US dollar interest rate q^*. Therefore, the return of investing a sum of money in a domestic interest-bearing asset for a certain period of time is the same as the return of investing in a similar foreign interest-bearing asset by converting the sum into a foreign currency while simultaneously purchasing a futures contract to convert the investment back at the end of the period. If the returns are different, an arbitrage transaction could, in theory, produce a risk-free return.

It is important to note that covered interest parity assumes that assets denominated in domestic and foreign currency are freely traded internationally (i.e., no capital controls) and have negligible transaction costs and similar risks. Given today's technology, these assumptions normally hold in the international financial markets, and so the parity condition is observed almost all the time (except for those countries where capital controls are still in place). However, there are times and situations in which the condition breaks down. Taylor (1989) finds that during the floating of the sterling in 1972 and the inception of the European Monetary System in 1979, significant departure had occurred from covered interest parity for periods long enough to challenge the theory.[1]

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[1] Other studies have attempted to rationalise these departures in terms of transactions costs, e.g., Frenkel and Levich (1977) and Clinton (1988).

One possibility is that in times of financial turmoil, true risks, or risks as perceived by market participants, might have changed, rendering the assumptions of covered interest parity inapplicable. Indeed, a recent BIS study by Baba and Packer (2008) finds that in the recent global financial crisis the turbulence in money markets has spilled over to FX swap markets amid a reappraisal of counterparty risks.[2] The spillover occurred, as European banks needed to secure US dollar funding to support their US conduits, while US banks – also facing increased financing difficulties and having to preserve funds on hand – became cautious in lending to their European counterparts, forcing the latter to resort to converting euros into dollars in the swap market. As soon as European banks (borrowers), perhaps with the exception of the well-known members on the LIBOR panel, were perceived to be riskier by US banks (lenders), a risk premium quickly developed, adding to the dollar funding rates in the swap.

In Chart 1, the green line measures how much the implied 12-month US dollar funding rate deviates from the corresponding LIBOR – the risk premium demanded by dollar lenders in the swap market or the departure from covered interest parity.[3,4] As can be seen, before the summer 2007 it oscillated around 0% but after that it had followed an upward trend. Around the beginning of September 2008, it shot up and fluctuated widely. Baba and Packer focus on the shorter end of the market in their study, but their findings yield similar flavour. Using CDS spreads and LIBOR-OIS spreads as proxies, they find evidence that increase in counterparty risks of European banks in general was the main driving force behind the departure from the parity condition during the turmoil.[5] The LIBOR-OIS spread is commonly used as a measure of market perceptions of potential banking insolvency in the economy of the underlying interest rate, i.e., a higher LIBOR-OIS spread implies higher banks' default risk.[6]

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[2] The paper covers the study until 12 September 2008, i.e., before the Lehman default.
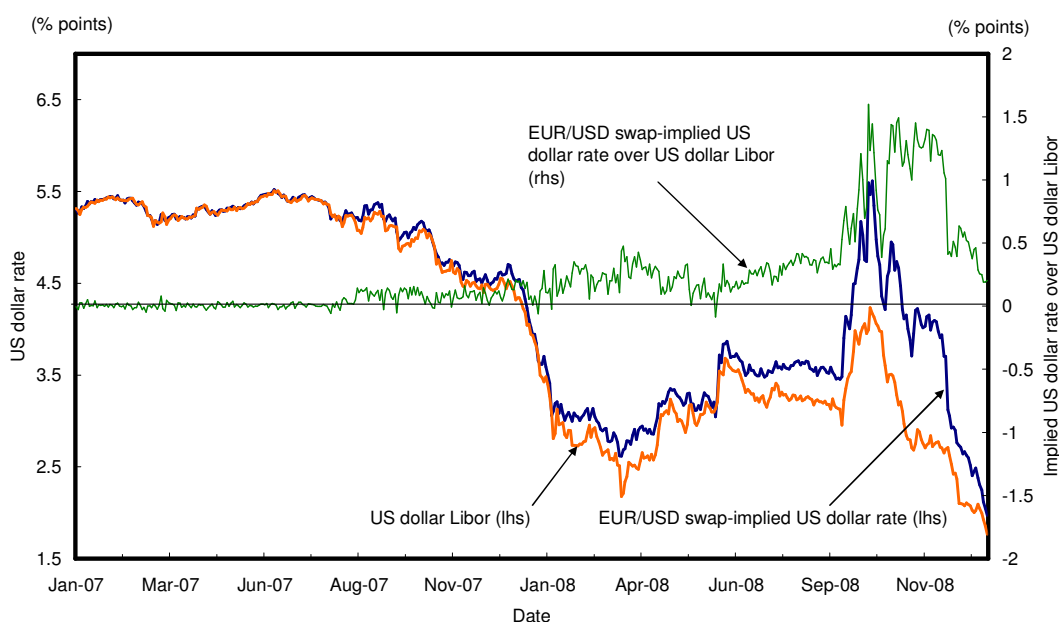
[3] The 3-month contracts show similar results.

[4] The data used in this paper are from Bloomberg.

[5] An overnight index swap (OIS) is an interest rate swap in which the floating leg is linked to an index of daily overnight rates. The two parties agree to exchange at maturity, on an agreed notional amount, the difference between interest accrued at the agreed fixed rate and interest accrued at the floating index rate over the life of the swap. The fixed rate is a proxy for expected future overnight interest rates. As overnight lending generally bears lower credit and liquidity risks, the credit risk and liquidity risk premiums contained in the overnight index swap rates should be small. Therefore, the spread of the 12-month LIBOR relative to 12-month OIS rate generally reflects the credit and liquidity risks of the interbank market.

[6] See an article written by Alan Greenspan in the last 2008 issue of *The Economist*, advocating the use of the LIBOR-OIS spread as a measure of market perceptions of extra capital needs for banks.

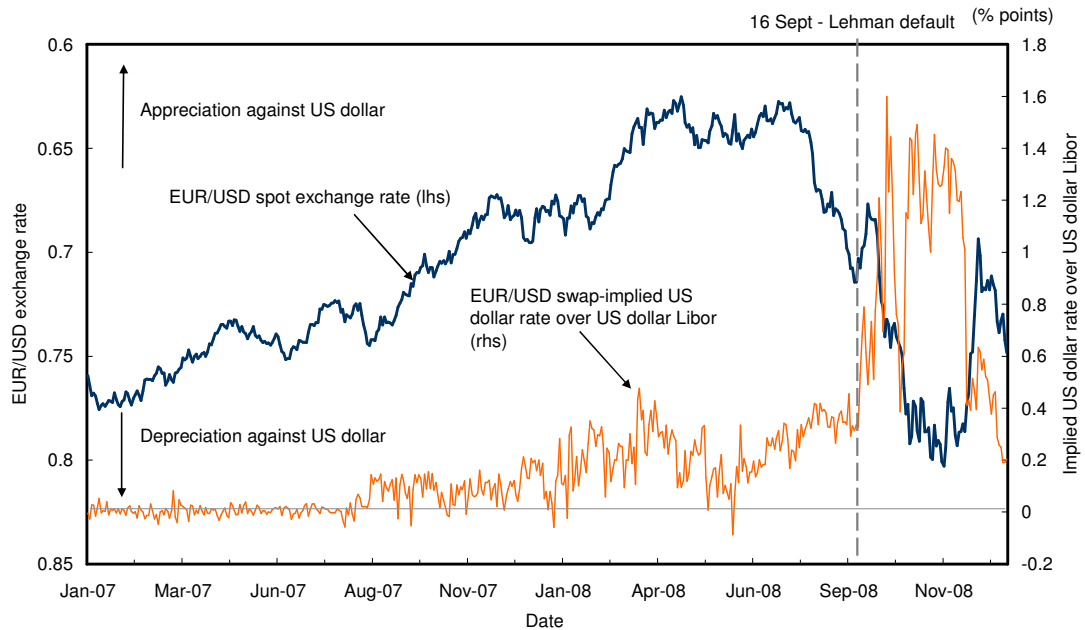**Chart 1.   12-month FX swap implied US dollar rate from euro**

III.   EFFECTS OF COUNTERPARTY RISKS ON THE FOREIGN EXCHANGE MARKET

The recent financial turmoil has also had a significant impact on the foreign exchange market.   As compared to financial crises in the past, one of the distinct characteristics of this crisis is how the resulting increase in counterparty risks paralyses the money market.   The impact of the crisis on the foreign exchange market and the channels through which it was transmitted have so far gone almost unnoticed by economists and policymakers.   The significance of the Baba-Packer study lies in the uncovering of the mechanism in which the rise in counterparty risks as a result of the turmoil feeds through from the money to the swap market.   This section points out that the financial turmoil has led to a reappraisal of counterparty risks of different banking sectors, which has in turn led to fundamental changes in international currency markets.

As European banks resorted to converting their euros into dollars to meet their funding requirements, the euro began to appreciate rapidly.   The euro had been on a long-term upward trend vis-à-vis the dollar before the news of the near-collapse of Bears Sterns in March 2008 (Chart 2).   It had begun to stabilise since then.   And when severe financial difficulties of Freddie and Fannie surfaced in around August 2008, it fell sharply.
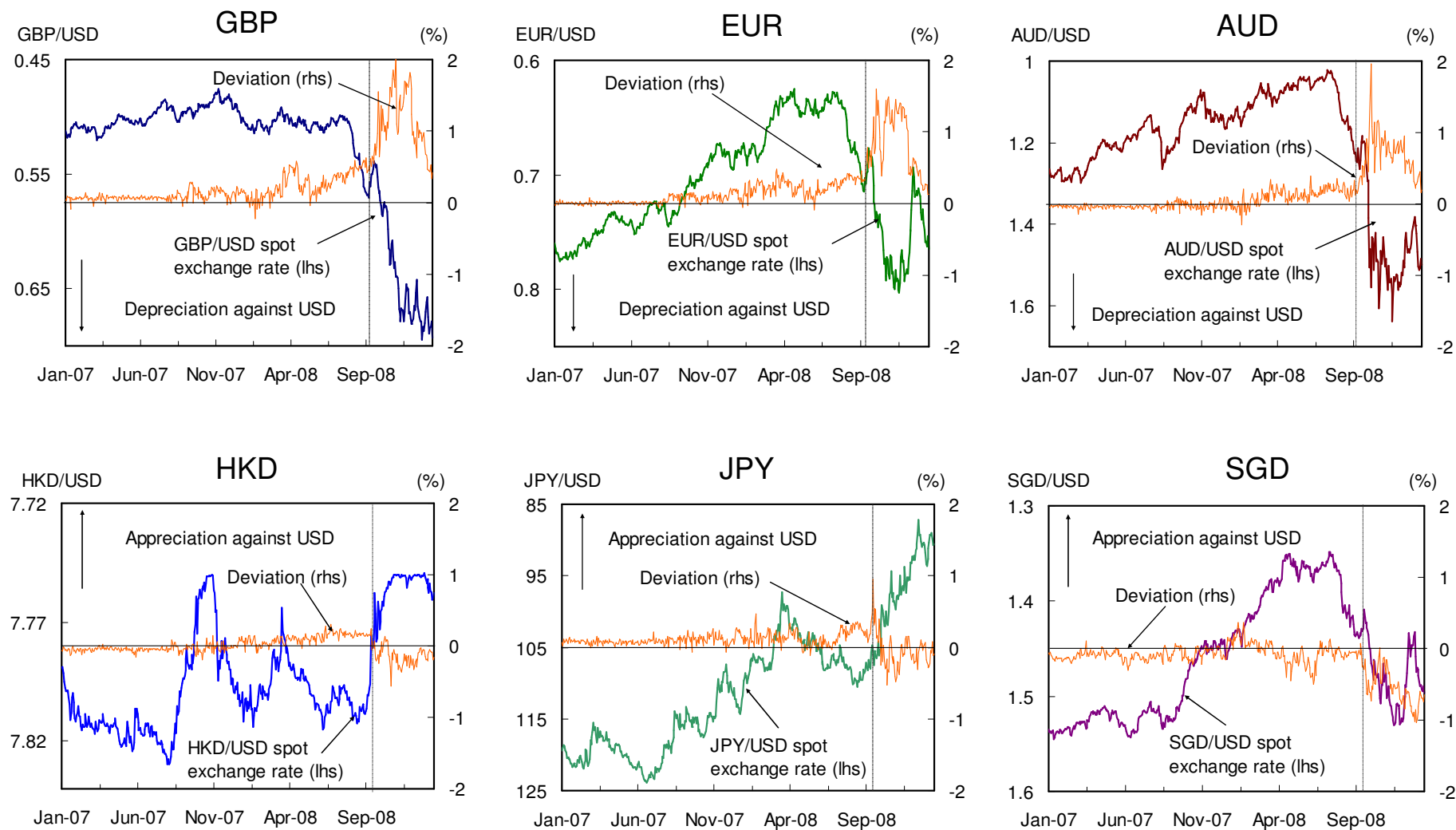
Chart 2. Deviation of 12-month FX swap implied US dollar rate from dollar LIBOR and EUR/USD exchange rate

Given that European banks are not alone in this global crisis, if this theory is correct, the same should also be observed in economies where financial institutions also suffered from a rise in counterparty risks, and their currencies should also experience sell-off to a similar extent.   In Chart 3, we plot the deviations of the various currencies' swap-implied US dollar funding rates from the corresponding LIBOR.   As can be seen, some economies saw a significantly higher swap-implied funding rate over the US dollar LIBOR after mid-September 2008 and, at the same time, a sharply lower currency (i.e., the pound and the Australian dollar), while others enjoyed a swap-implied discount from the US dollar LIBOR and, at the same time, a much stronger currency (i.e., the yen and the Hong Kong dollar).[7]
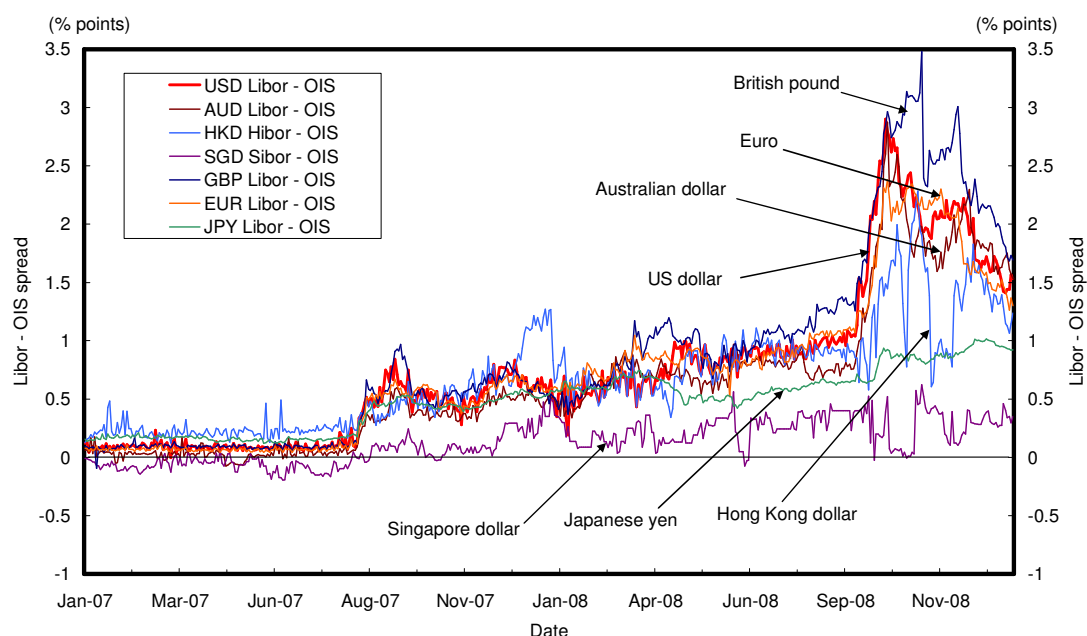
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[7]   The picture is less clear for the Singapore dollar.

Chart 3. Deviations of 12-month FX swaps implied US dollar rate from dollar LIBOR and their respective exchange rates

If Baba and Packer are right in pointing out that what recently happened in the swap market reflects essentially a rise in counterparty risks spilling over from the money market, the amount of premium or discount as reflected in the swap-implied US dollar funding rates of different FX swaps can be taken as a measure of relative risk of the banking sectors of the economies concerned. The results of such measure should be supported by the evidence in the LIBOR-OIS spread that reflects market perceptions of potential banking insolvency.[8] The 12-month LIBOR (or HIBOR)-OIS spreads of the respective economies in Chart 4 clearly show that the banking sectors in the US, the Euro area, the UK and Australia had a substantial higher default risk than that in Hong Kong, Japanese and Singapore in the last quarter of 2008. These observations are consistent with the premium or discount as reflected in the swap-implied US dollar funding rates of different FX swaps.

Chart 4. 12-month LIBOR(HIBOR)-OIS spreads

To test statistically whether the changes of the differences between the LIBOR-OIS spreads of the currencies concerned and the US dollar had effects on the changes and volatility of their FX swap deviations, we employ the EGARCH(1,1) model proposed by Nelson (1991) to test their data series from 9 August 2007 to 30 January 2009.[9] Table 1 show that the series are not stationary in level but are stationary in the first difference according to the augmented Dickey-Fuller test. The EGARCH(1,1) model in the first difference we use can be written as

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[8] The CDS market only covers a few banks in Hong Kong and Singapore. Therefore, their CDS spreads do not represent the risk of the banking sectors as a whole.

[9] This follows Taylor and Williams (2008a, b) to choose 9 August 2007 to mark the inception of the turmoil, when BNP Paribas froze redemptions for three of its investment funds.

Mean equation:

$$dFXdev_t = a + b \times d(LIBOR - OIS)_t^{spread} + \varepsilon_t \quad \varepsilon_t \sim N(0, \sigma_t^2) \tag{2}$$

where

$$FXdev_t = \frac{S_t}{F_t}(1 + r_t) - (1 + q_t) \equiv q_t^* - q_t$$

$$(LIBOR - OIS)_t^{spread} = (LIBOR - OIS)_t^{FC} - (LIBOR - OIS)_t^{USD}$$

Variance equation:

$$\ln(\sigma_t^2) = \alpha + \beta \ln(\sigma_{t-1}^2) + \gamma \frac{\varepsilon_{t-1}}{\sigma_{t-1}} + \eta \left(\left| \frac{\varepsilon_{t-1}}{\sigma_{t-1}} \right| - \sqrt{2/\pi} \right) \tag{3}$$

If the relative risk of the banking systems of the economies concerned is a determinant of the premium or discount as reflected in the swap-implied US dollar funding rates of different FX swaps, the coefficient b in Eq.(2) should be positive and statistically significant.

Table 1. Augmented Dickey-Fuller test on the variables $FXdev_t$ and $(LIBOR - OIS)_t^{spread}$

Sample period: 9 August 2007 to 30 January 2009
No. of observation: 349

Currency	$FXdev_t$		$(LIBOR - OIS)_t^{spread}$	
	Level	Daily change	Level	Daily change
GBP	-2.398	-4.983***	-2.490	-5.461***
EUR	-2.378	-3.837***	-3.719***	-4.501***
AUD	-2.115	-4.129***	-1.947	-6.442***
JPY	-2.434	-5.751***	-2.071	-4.183***
HKD	-1.752	-6.029***	-2.391	-5.447***
SGD	-0.110	-5.335***	-2.361	-5.004***

1.) ADF statistics are from the Augmented Dickey-Fuller unit root test. The critical ADF values at the 10%, 5% and 1% significance level are -2.57, -2.87 and -3.44 respectively.
2.) *, ** and *** indicate significant at 10%, 5% and 1% levels respectively.
3.) The lag length of the ADF test is selected according to the Schwarz Information Criteria with maximum lags of 16.

The results in Table 2 show the coefficients *b* for the six currencies are positive and significant at the 1% level. This indicates that under the turmoil, FX swap deviations in the euro, the pound and the Australian dollar tended to widen upward when counterparty risk was heightened for the financial institution in these economies relative to US counterparts. On the other hand, the deviations in the Hong Kong dollar, the yen and the Singapore dollar tended to go downward as counterparty risk of the financial institutions in these economies were perceived to low relative to US counterparts.

Therefore, in contrast to European and Australian banks (which need to convert their currencies into US dollars to meet their funding requirements), Hong Kong, Japanese and Singapore banks with swap-implied discounts from the US dollar LIBOR (i.e., with less default risk) attract financial institutions (probably US banks) with US dollars on hand to sell US dollars to these Asian banks at spot in the FX swaps.[10] In this connection, it becomes readily understandable why these Asian currencies appreciated against the US dollar after the Lehman incident.

IV. CONCLUDING REMARKS

This note analyses the impact of the global credit crisis on the FX swap market and discusses its potential implications. A recent BIS study finds that the turbulence in money markets has spilled over to FX swap markets amid a reappraisal of counterparty risks during the recent financial turmoil. The spillover occurred, as European banks needed to secure US dollar funding to support their US conduits while US banks were cautious in lending to them. This forced the European banks to resort to converting their euros into dollars in the swap market, giving rise to a risk premium in the dollar funding rates in the swap. In this note, we extend the BIS analysis to examine the situations of five other currencies. We find that (i) the risk premiums have indeed gone in tandem with the spreads of money market rates over their corresponding overnight index swaps across the economies, a popular measure of potential banking insolvency; and (ii) the risk premiums bear a negative relationship with the strength of the spot rates of the respective currencies, which is consistent with the increased pressure in the swap markets. The implication of the analysis is that the directions of fund flows among different economies may reflect the relative safety and soundness of their banking systems during the credit crisis period.

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[10] The counterparty risk at the forward legs of the swaps is also relative low for these Asian banks.

Table 2.   Estimation results of EGARCH(1,1) model

Sample period: 10 August 2007 to 30 January 2009 (No. of observation = 348 after adjustment)

| Currency | Mean equation | | Variance equation | | | | Ljung-Box test up to lag 24 | | Adj R-squared |
	a	b	α	β	γ	η	Standardized residuals (P-value)	Squared standardized residuals (P-value)	
GBP	0.0006 (0.002)	**0.884**** **(0.023)**	-0.772** (0.262)	0.947** (0.029)	0.147 (0.094)	0.585** (0.149)	13.875 (0.949)	17.912 (0.807)	0.746
EUR	0.002 (0.002)	**0.856**** **(0.025)**	-0.387 (0.238)	0.988** (0.021)	0.139 (0.106)	0.454* (0.212)	17.528 (0.825)	18.759 (0.765)	0.526
AUD	0.003 (0.003)	**0.717**** **(0.037)**	-0.367** (0.096)	0.971** (0.015)	0.127 (0.069)	0.279** (0.074)	35.233 (0.065)	16.628 (0.864)	0.467
JPY	0.002 (0.002)	**0.876**** **(0.022)**	-0.755* (0.325)	0.940** (0.037)	0.004 (0.097)	0.551* (0.226)	30.836 (0.159)	20.637 (0.660)	0.440
HKD	0.003 (0.003)	**0.510**** **(0.037)**	-0.416 (0.265)	0.967** (0.038)	0.080 (0.072)	0.301** (0.086)	38.250 (0.033)	32.694 (0.111)	0.422
SGD	-0.0002 (0.004)	**0.304**** **(0.029)**	-0.503 (0.286)	0.946** (0.047)	-0.026 (0.074)	0.301** (0.092)	43.209 (0.009)	23.188 (0.509)	0.158

1.)   Numbers in parentheses are Bollerslev-Wooldrige robust standard errors. * and ** indicate significant at 5% and 1% levels respectively.

2.)   The Ljung-Box test (Q-statistics) identifies whether the autocorrelations among data are jointly zero up to a specified lag. Accepting the null hypothesis of the test means the data is not serial correlated. The standardised residual is the residual divided by the estimated volatility.

3.)   If the model fits well, the standardized residual will be serial uncorrelated and homoskedastic. If the mean equation is correctly specified, the Q-statistic of the standardized residual should not be significant; if the variance equation is correctly specified, the Q-statistics of the squared standardized residuals should not be significant.

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